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ENLARGED SYLLABUS

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A Course of LECTURES

I N

Experimental Philosophy;

As usually exhibited on a PROPER APPARATUS,

By BENJAMIN DONN,

Teacher of the MATHEMATICS.

Nature and Nature's Laws lay hid in Night,
GOD said let *Newton* be, and all was Light.

POPE.

SECOND EDITION.

Printed for and sold by the AUTHOR, at BRISTOL.

M,DCC,LXXX.

PRICE ONE SHILLING.



ADVERTISEMENT.

THIS enlarged SYLLABUS of my PUBLIC LECTURES, giving a more particular account of them than room would admit in the common Syllabus, may also serve as a memorial book, (after the lectures are over) assisting the memory in recollecting some particular subjects and experiments.

I beg leave to observe, that though the general heads, number, and contents of the lectures, as nearly as can be at present ascertained, will be as here drawn up; yet I do not by any means look upon myself as bound to follow them exactly, as many circumstances may arise, which may incline me to add to, omit, or alter such parts as may appear at the time more convenient.

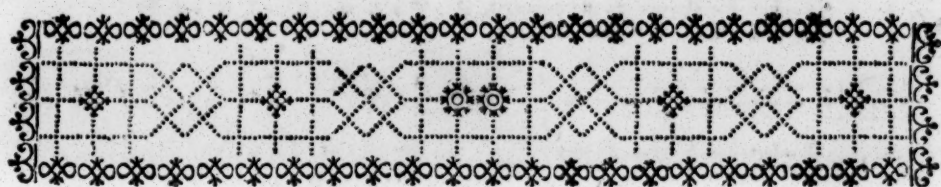
As it may be expected I should say something of my Apparatus, I shall briefly observe, that if it is not as *gaudy* as some, or so *pompous* as others, yet I flatter myself it will be found *as useful as any*; being in general, *simple* in the construction, and *well adapted* to illustrate and prove the several propositions, and, therefore, in a word, may be justly called, as in the title page, a PROPER APPARATUS.

☞ LADIES and GENTLEMEN may be taught the Use of the GLOBES, MAPS, and CHARTS, &c. during this course.

The Author also teaches Arithmetic, Book-keeping, Navigation, the Elements of Algebra, Astronomy, Fluxions, Gauging, Geometry, Mensuration, Philosophy, Surveying, &c. in a rational and expeditious manner.

* * Just published, Outlines of a *General Academy* of English Literature, Arts, and Sciences; which, as soon as a certain number of Pupils are engaged, is intended to be opened by the Author. Price 3d.

ESTATES SURVEYED.



LECTURE I.

Of MATTER in General, COHESION, &c.

THE design is to give a Course of Lectures in Natural Philosophy, a science which makes us acquainted with many of the laws by which the alwise Creator governs the material world; a science well adapted to, and worthy the employment of a rational mind.

No one, who is desirous of knowledge, should be ignorant of Natural Philosophy.

A considerable acquaintance with this science may now be easily acquired.

In this course, my design, at the same time as I would willingly entertain, is to prove a regular chain of propositions, whereby Ladies and Gentlemen, without any previous knowledge of these subjects, may readily understand the principal phenomena of nature, which have been discovered by the most learned philosophers in several ages.

Sir Isaac Newton has alone made more important discoveries, and cleared more difficulties in his *Principia* and *Optics*, than all the philosophers who were before him.

It is necessary that every person who would understand Natural Philosophy, Geography, and Astronomy, should know something of Geometry.

Similar surfaces are in proportion as the squares of their like sides.

4 LECTURE I. continued.

Similar solids are in proportion to each other as the cubes of their like sides.

N. B. For the sake of young persons, &c. when a term is made use of in the lectures, which it is supposed may not be generally understood, care will be taken to explain it; and this, it is hoped, will be excused by our more learned auditors.

MATTER or body has both extension and resistance. Matter is indefinitely divisible.

An inch divisible into 274,625,000 visible parts.

Lavender so divided as to fill a space of 3456 millions of times its natural bulk, &c.

There are in nature several powers called ATTRACTIVE-
TIONS; as that of COHESION, MAGNETISM, GRAVITY,
and ELECTRICITY, which will be treated of in this
course; but in this lecture we shall treat only of Cohe-
sion, viz. that power by which the particles of matter
adhere and form bodies.

This may be shewn in several instances, as by the
adhesion of leaden balls, cements, solders, &c. rise
of water in capillary tubes, vegetables, &c.

There is both an *attractive* and *repulsive* power in
nature, on which depend the principal operations in
chemistry.

The attractive power of cohesion in different bodies
is different; as for instance, the particles of water are
attracted more by glass than by each other; but the
particles of quicksilver are more attracted by them-
selves than by glass.

Hence may be illustrated the solution of bodies in
menstruums.

The *Vitriolic Acid* attracts the particles of mercury
more strongly than of silver; copper more than mer-
cury; iron more than copper; calcareous earth more
than iron; and fixed alkali more than either, &c.

The



LECTURE I. continued. 5

The *Nitrous Acid* attracts quicksilver more than silver; copper more than quicksilver; lead more than copper; iron more than lead; calcareous earth more than iron; and fixed alkali more than either, &c. &c. as may be seen in chemical writers, in their tables of *attraction*, as called by some, or of *affinities*, as named by others.

The ascent of *smoke, vapours, &c.*

The *air* has a power of attracting and dissolving water.

Of *dew, rain, snow, hail, and mist or fogs.*

The vapours which are raised and suspended during the heat of the day, are precipitated by cold in the night, and coalesce into drops of DEW.

If the air is sufficiently cold so as to freeze, the drops of dew become frozen, and so the trees, shrubs, &c. appear frosted, called a WHITE or HOARY FROST.

If the vapours, &c. raise pretty high in the atmosphere by the wind, &c. where there is not heat enough to keep them in a dissolved state, they form CLOUDS.

When the clouds are much increased by a continual addition of vapour, and their particles are driven close together by the impulse of the wind, they will run into drops heavier than the air, and fall down in showers of RAIN.

If the clouds are frozen before they are formed into drops, and then are driven together and condensed so as to become heavier than the air, they must fall down in flakes of SNOW.

But if the watery particles are formed into drops of rain, and then are frozen, they descend in showers of HAIL.

When the air near the surface of the earth is replete with vapours and a cold breeze springs up, as it often does,

6 LECTURE I. continued.

does, from the sea, rivers, &c. the solution of these vapours is checked, and clouds are formed in the lowest part of the atmosphere, and are then by us called Mist or Fog: But when the sun has given a sufficient degree of warmth to the air, it again dissolves those watery particles, and it generally clears up.

Method of impregnating water with fixed air, and thereby to make artificial Pyrmont or Seltzer water.

To foliate looking glass.

Method of silvering metals, &c.

LECTURE II.

Of MAGNETISM and GRAVITY.

THE attraction of the MAGNET or LOADSTONE is peculiar to iron or iron ore.

Artificial magnets are more easily procured, and more convenient than the natural stone.

Every magnet has *two poles*; and if the magnet is freely suspended, one will tend towards the north, and is therefore called the north pole; and the other, which tends towards the south, is called the south pole of the magnet.

Either pole of a magnet will attract iron.

The magnetic power acts through all bodies but iron.

There is an *attractive* and *repulsive* power in magnets. For distinction sake let us call the *north pole* of a magnet *positive*, the *south pole* *negative*; then we may say a positive and a negative will attract each other; but two positives, or two negatives, will repel.

At London, in the year 1580, the magnetic needle pointed $11^{\circ} 15'$ eastward of the true north, but now points about 23 degrees westward; this is called the variation

variation of the compass, and is different at different places in the same time.

Steel needles, which would hang in an horizontal position before touching, will dip when the magnetic virtue is communicated to them.

The magnetic virtue may be destroyed or restored.

Iron bars acquire a magnetic virtue by standing long in one position.

Position of iron filings at the poles and equator of one or two magnets.

Method of making artificial magnets.

The MOMENTUM of a body in motion is expressed by the product of the number expressing the weight or quantity of matter into the number expressing its velocity.

Sir ISAAC NEWTON's Laws of Motion.

Law 1. Every body, in proportion to its quantity of matter, perseveres in its present state of rest, or of uniform motion in a right line, unless it be compelled to change that state by forces impressed thereon.

Law 2. Whatever motion, or alteration of motion, is produced in any body, it is always proportional to, and in direction of the moving force impressed.

Law 3. To every action there is always opposed an equal re-action; or, in other words, the mutual actions of two bodies upon each other are always equal and contrary.

By the preceding laws may be easily explained the nature of swimming, rowing, and flying; also compound motion, as of a ship sailing in a current.

The ATTRACTION of GRAVITY.

The Attraction of Gravity, and the Intensity of Light and Odours, decrease as the square of the distance increases.

8 LECTURE II. continued.

A heavy body let fall freely from a state of rest, falls through the space of 16 feet and a tenth in the first second of time.

The spaces fallen through each second are as the odd numbers, 1, 3, 5, 7, 9, &c.

The spaces described by falling bodies are as the squares of the times.

Hence may be found the height of a sea cliff, &c. by observing the time a stone is falling.

A *Projectile*, or a ball fired out of a gun or mortar, abstracting from the resistance of the air, describes a curve, called by mathematicians a *Parabola*. And if at going out of the gun it makes with the horizontal plane an angle of 45 degrees, the distance it falls off, called the amplitude, will be greater than if fired at any other angle.

Of PENDULUMS.

The times of vibration in a curve, called a Cycloid, will be the same, whether the pendulum describes longer or shorter arches.

A pendulum, 39 inches and 2 tenths in length, in England, vibrates seconds of time.

The times of vibration of pendulums are as the square root of their length.

The weight of the bob makes no alteration in the time of vibration.

To determine the center of oscillation or vibration; also the center of percussion, or the place in a stick which will give the greatest blow.

Metals expand by heat, and contract by cold.

According to Dr. Desaguliers, if iron lengthens 80 parts, steel will lengthen with the same degree of heat 85 such parts, copper 89, brass 110, iron 153, lead 155.

In

LECTURE II. continued. 9

In Mr. Ellicot's pyrometer, which we make use of, if the metal lengthens the 7200th part of an inch, it will move the index one degree.

CENTERS of GRAVITY *and* MAGNITUDE.

The center of gravity being supported, the body will not fall.

The center of gravity always descends, notwithstanding the double cone appearing to go up hill.

Line of direction.

Why some bodies stand, others fall, some slide, and others roll.

Center of gravity of a triangle, &c.

To find mechanically the center of gravity of an irregular figure.

Of the BALANCE, *or Common Scales.*

In the balance and steel-yard there will be an equilibrium, when the weight multiplied by its distance from the fulcrum on one side, is equal to the product of the weight and distance from the fulcrum on the other side.

If several weights are hung on, the sum of the momentums on one side must be equal to the sum of the momentums on the other side.

To discover a false balance.

LECTURE III.

The MECHANIC POWERS.

FIRST, of the lever.

Three sorts. 1st. Is when the fulcrum or center on which it turns, is between the weight and power; as scissars, &c.

B

2d Kind,

2d Kind, when the fulcrum is at one end, the power at the other, and the weight between them; as doors, &c.

3d Kind, when the fulcrum is at one end, the weight at the other, and the power or hand between them; as in tweezers, raising a ladder, &c.

Of the HAND-BARROW.

How a weak man may carry a part (only proportionable to his strength) of the same burden with a strong man.

How horses of unequal strength may draw equally.

Of the HEBSTOCK, a German machine.

Of PULLIES, or common ship blocks, whether singly or variously combined.

The WHEEL and AXIS, as the wheel for raising water out of wells, or the capstane and windlafs of a ship.

The INCLINED PLANE, as slips at wharfs for drawing up of masts, &c.

Of friction.

The WEDGE for splitting wood, &c.

The SCREW.

In all these machines, and also in compound machines, as CRANES, &c. there will be an equilibrium, when the momentum of the power is equal to that of the weight; or, in other words, as much less power will sustain the weight, as the velocity of the power is is greater than the velocity of the weight.

Of WHEEL-CARRIAGES.

Large wheels lessen, or more easily overcome an obstacle than small wheels, &c.

A CRANE shewn, in which one hundred will sustain 40 hundred, or two tons

LECTURE III. continued. 11

A machine with which one hundred would sustain 2530 hundred, or 126 tons, &c.

LECTURE IV.

HYDROSTATICS *and* HYDRAULICS, *or Properties of Fluids in general.*

HYDROSTATICS is the science which considers the equilibrium and pressure of fluids in general; and HYDRAULICS treats of the running of fluids, through holes, &c.

A FLUID is a body that yields to any impressed force, and whose parts, by yielding, are easily separated from each other.

A LIQUID is a fluid which acquires a surface parallel to the surface of the earth, and has the peculiar quality of adhering to, and wetting most bodies immersed in it.

Some bodies are very compressible, as air; and others, as water, admit of very little compression; so that it may in all machines be looked on as incompressible.

To explain the principles of Hydrostatics, fluids contained in vessels may be considered as divided into several horizontal planes, or imaginary surfaces.

Hence fluids gravitate, (*in proprio loco*) as water in water, &c.

Fluids contained in a vessel may also be considered as divided into perpendicular columns, &c.

Fluids press in all directions every way alike, as much upwards as downwards.

The upward pressure will support lead from sinking.

Light wood will not swim if the upward pressure be taken of.

The pressure of fluids on equal bases, is proportional to the height only, without any regard to the quantity.

The WATER LEVEL, and its use.

In taking a level, add all the forward and all the backward heights respectively together. If the forward heights are greatest, the first place is the highest.

If the distance is considerable, a small correction must be made for the curvature of the earth.

Water may by pipes be conveyed from one hill to another.

Specific gravity is the proportional weight of fluids or solids of equal bulk.

If a body of lighter specific gravity be put into a fluid, it swims; if heavier, sinks.

Story of the crown of Hiero, King of Syracuse, illustrated.

A body weighed in a fluid lighter than itself, loses as much of its weight, as is the weight of an equal bulk of the fluid.

Hence may be found the specific gravity of fluids, by weighing one and the same solid in them

Two bodies of equal weight in air, but of different specific gravity, and each heavier than water, will not be of equal weight in water.

Hence to discover bad money.—A good guinea standard weighing 129 grains, loses in water $7\frac{1}{4}$ grains; if more it is not standard.

The specific gravity of fluids may be found without weighing, as quicksilver and water.

A Table of the specific Gravity of Bodies.

Fine Gold — —	19. 640	Oil of Tartar — —	1. 550
Standard Gold — —	17. 793	Bezoar — —	1. 500
* Platina — —	16. 000	Honey — —	1. 450
Quickfilver — —	14. 000	Gum Arabick — —	1. 375
Lead — —	11. 325	Spirit of Nitre — —	1. 315
Fine Silver — —	11. 091	Aqua Fortis — —	1. 300
Standard Silver — —	10. 535	Pitch — —	1. 150
Bismuth — —	9. 700	Spirit of Salt — —	1. 130
Copper — —	9. 000	Craffamen. of human	} 1. 126
Cast Brass — —	8. 000	Blood — —	
Steel — —	7. 850	Spirit of Urine — —	1. 120
Iron — —	7. 645	Human Blood — —	1. 054
Tin — —	7. 320	Amber — —	1. 040
Glass of Antimony —	5. 280	Serum of human Blood	1. 030
A Pseudo Topaz —	4. 270	Milk — —	1. 030
A Diamond — —	3. 400	Urine — —	1. 030
Clear Chrystal Glass -	3. 150	Dry Box-Wood — —	1. 030
Iceland Chrystal -	2. 720	Sea Water — —	1. 030
Fine Marble — —	2. 700	Common Water — —	1. 000
Rock Chrystal — —	2. 650	Camphire — —	0. 996
Common Green Glass -	2. 620	Bees-Wax — —	0. 955
Stone of a mean Gravity	2. 500	Linseed Oil — —	0. 932
Sal Gemmæ — —	2. 143	Dry Oak — —	0. 925
Brick — —	2. 000	Oil Olive — —	0. 913
Nitre — —	1. 900	Spirit of Turpentine -	0. 874
Alabaster — —	1. 875	Rectified Spirit of Wine	0. 866
Dry Ivory — —	1. 825	Dry Ash — —	0. 800
Brimstone — —	1. 800	Dry Maple — —	0. 755
Dantzick Vitriol —	1. 715	Dry Elm — —	0. 600
Allum — —	1. 714	Dry Fir — —	0. 550
Borax — —	1. 714	Cork — —	0. 240
Calculus Humanus -	1. 700	Air — —	0. 001
Oil of Vitriol — —	1. 700		

* Platina is a perfect metal lately discovered. It comes to us in small grains, resembling iron filings. Platina, like gold, will bear the greatest heat we can produce in our furnaces, without diminution of weight. Like gold, it is soluble only by liver of sulphur, and a mixture of the nitrous and marine acids; and thence it is difficult to detect when mixed with gold; therefore it may be useful to observe, that if on dissolving the suspected gold in aqua regia, adding a little solution of sal ammoniac, a very fine yellow precipitate immediately falls down, it contains platina, but if no precipitation ensues, it is pure gold.

Running

14 L E C T U R E IV. continued.

Running of syphons, }
Tantalus' cup, } explained.
Funnel of command, }

A common fountain, or jet d'eau.

Intermitting springs explained.

A well in Devonshire, at Brixham, near Torbay, which ebbs and flows several times an hour, accounted for.

The velocity of water running through holes in the sides or bottoms of vessels, is as the square root of the height of the fluid above the holes.

If holes be made in the side of a vessel, the middle hole will spout farthest, &c,

A useful hint, the purest water is the lightest.

L E C T U R E V.

PNEUMATICS.

HAVING considered the nature of fluids in general, we now proceed to consider the properties of particular fluids; and first of the Air, or that fluid which surrounds our earth to a considerable height, to 80 miles or upwards, called the Atmosphere.

The principal properties of the air are, 1. That it is a heavy body and a fluid, and therefore must press equally in all directions.

2. That it is a springy or elastic body.

3. That it may be rarefied or greatly expanded by heat.

4. That it may be condensed or compressed.

In this lecture we shall confine ourselves to the weight or pressure of the air, and phenomena depending thereon.

That

LECTURE V. continued. 15

That the air is a heavy body may be shewn by weighing it in a balance, when it will be found that a pint of air weighs about 9 grains.

That a glass vessel, called a receiver, placed over the hole of the pump, is not fixed down by any sucking or drawing quality in the pump, as some imagine, but really by the pressure of the air.

That the quicksilver, or barometer, is sustained by the pressure of the air on the surface of the quicksilver in the open basin.

The air at a mean state will support a column of quicksilver of about $29\frac{1}{2}$ inches in height, and therefore presses on a square inch with a weight of 15lb. and hence on a square foot with 144 times 15lb. or 2160lb. and on 14 square feet, or the surface of a middle sized man, with a force of 14 times 2160lb. or 30240lb. which is about $13\frac{1}{2}$ tons.

Some of the observations which have been made on the barometer by Dr. Halley, are

1st. That in calm weather, when the air is inclined to rain, the mercury is commonly low.

2d. That in serene, good, settled weather, the mercury is generally high.

3d. That upon very great winds, though they be not accompanied with rain, the mercury sinks lowest of all, with relation to the point of the compass the wind blows from.

4th. That, *ceteris paribus*, the greatest heights of the mercury are found upon easterly and north easterly winds.

5th. That in calm frosty weather the mercury generally stands high.

6th. That after very great storms of wind, when
the

16 LECTURE V. continued.

the quicksilver has been low, it generally rises again very fast.

Water is raised in the common pump by the pressure of the air on the water in the well.

Hence appears the reason why the common pump cannot raise water higher than about 33 feet above its lowest valve.

Of the forcing pump, and Newsham's fire engine.

The weight or pressure of the air may be farther illustrated by a variety of entertaining experiments; as pressing quicksilver through wood, &c. breaking a bladder, and an artificial fountain.

LECTURE VI.

PNEUMATICS continued.

A Feather in an exhausted receiver falls as fast as a guinea, when the resistance of the air is taken off.

That the air is a springy or elastic body may be shewn by several experiments.

An experiment with the lungs glass, to shew how animals die in vacuo.

That air is capable of rarefaction and condensation, proved by several experiments.

This lecture may conclude with miscellaneous experiments, as, that air is contained plentifully in most bodies.

Air is the medium of sound.

A candle will not burn without air, &c.

After Lecture VI. may be given the additional Lecture on CHEMISTRY, viz. on several kinds of GASES, called FIXED AIR, INFLAMMABLE, NITROUS, &c.

LECTURE VII.

OPTICS.

BY OPTICS we understand the science of vision, light, and colours.

A beam of light, what.

A ray, what.

Light is material.

A medium in an optical sense, what.

A ray of light proceeds in the direction of right lines, unless turned out of its way by the action of bodies.

The motion of light is progressive, taking about seven or eight minutes in passing over a space of ninety-five millions of miles.

Particles of light are indefinitely small.

Of CATOPTRICS, or Properties of Reflected Light.

The first law of catoptrics is, that the angle of incidence is equal to the angle of reflection.

Corollary. Reflected light proceeds in the shortest way possible.

2d Law. Every radiant point, when seen by reflection, appears in the place where the reflected ray produced meets the perpendicular drawn from the radiant point to the reflecting surface.

Hence, if we look in a looking-glass, the image appears as far behind the glass, as the object is really before it.

In a plane mirror, or looking-glass, the image is equal and similar to the object.

How long a person must buy a glass to see himself in it.

To purchase a good glass; with some entertaining experiments with plane glasses.

Of SPHERICAL MIRROURS.

A *concave mirror* converges the rays of the sun to a focus, or burning point.

The focus of parallel rays is in the middle between the center of the mirror and the mirror.

Mr. *Villette* had a mirror 3 feet 11 inches in diameter, and focal distance 3 feet 2 inches. This mirror condensed the rays 17257 times, and rays but 35 times denser than common fire have a power of burning equal to wood fire. Hence 'tis computed the intenseness of the solar rays so condensed is 493 times greater than common fire.

A silver six-pence hath been melted by it in 7 seconds.

A copper halfpenny ran with a hole in 30 seconds.

Tin melted in 3 seconds.

Cast iron in 16 seconds, &c.

If the flame of a candle be placed in the principal focus, the mirror will seem all in flames; the reflected rays being parallel, and the light so strong, that *Tacquet* affirms that he had read at the distance of 400 feet.

Those images which appear on the same side of the mirror with the object are inverted, and those which appear behind the speculum are erect.

When the distance of the object from the mirror is less than half the radius, the image appears behind the speculum.

As

LECTURE VII. continued. 19

As the object moves nearer to the speculum before, so likewise does the image behind; and when the object touches the speculum, the image does the same.

The length or breadth of an object and its image, are as their distances from the center.

Of CONVEX SPHERICAL MIRROURS.

The focus of a convex mirrour is imaginary; and of parallel rays, is in the midway between the speculum and the center of its curvature.

The rays always proceed diverging from a convex surface.

The image in convex mirrours appears always diminished and erect behind the speculum, between the limits of half the radius and the mirrour.

Regular figures may appear distorted, and distorted figures regular.

LECTURE VIII.

DIOPTRICS, or *Properties of Refracted Light.*

A Perpendicular ray suffers no refraction, but an oblique one is refracted or turned out of its way in passing through mediums of different density.

An optical deception, as 1s. appearing to be equal to 3s. 6d. &c.

There is always a constant proportion between the sines of incidence and refraction; out of air into water as 4 to 3, *et contra*; out of air into glass about 17 to 11; different kinds of glass having different densities.

The denser a medium is, the greater is its refractive power.

Convex surfaces converge the rays, and concave diverge them.

20 LECTURE VIII. continued.

The several kinds of *Glass Lenses* shewn, viz.

Plano convex; double convex; plano concave; double concave; and the meniscus, or lunette.

An easy way to find experimentally the focus of a lens.

The *focus* of a *convex lens* is real, and in a *plano convex* the focus of the solar rays is equal to the diameter of the sphere if compleated.

But the *focus* of a *double convex lens* is but half the diameter, or equal to the radius.

The image in the focus is inverted.

The rays passing through *concave lenses* are diverged, and form no image; and therefore the focus is imaginary behind the lense.

Why *convex lenses magnify* objects, and why *concave diminish*.

Description of an * *Eye*, &c. with the dissection so far as is necessary to explain the nature of vision, principal diseases, &c.

Why the *optic nerve* is not inserted in the optic axis.

The image of an object is inverted at the bottom of the eye, though we judge of the object as erect.

Some defects of the eye how remedied by glasses, &c.

Why we do not see double with two eyes.

* As 1st. The eye-brow. 2. Eye-lids and eye-lashes, their use. 3. Sclerotia and choroides. 4. Tunica conjunctiva and cornea; inflammation of that tunic. 5. Pupil and iris. 6. Of the first or aqueous humour. 7. Of the crystalline humour, its disease and remedy. 8. Of ligamentum ciliare. 9. Of the vitreous humour. 10. Of the optic nerve and retina, with its disease, &c.

☞ The first convenient day after this lecture may be given the additional Lecture on Light and Colours, Microscopes, Telescopes, &c.

LECTURE

LECTURE IX.

ELECTRICITY.

ELECTRICITY is so called from the Greek word for Amber.

Amber, glass, sealing-wax, and a number of other substances, being excited by friction, will attract light bodies.

All known substances are by Electricians divided into conductors and non-conductors of the electric fluid.

Of excited electricity.

Of communicated electricity.

Glass, silk, wax, &c. are non-conductors of the electric fluid.

Metals, moisture, &c. are conductors of the electric fluid.

The electric fluid comes chiefly from the ground.

An electrometer.

A variety of entertaining experiments on electrical attraction and repulsion.

Experiments on the electrical stool.

Of pointed bodies.

Pointed bodies carry off the electrical fluid; also attract the electrical fluid at a considerable distance, much greater than blunt bodies, illustrated by a variety of entertaining experiments.

The Electrical orrery, &c.

Manner of charging and discharging of jars, and giving the electrical shock.

LECTURE X.

ELECTRICITY continued.

OF positive and negative electricity.

To give the shock by water.

By the magic picture.

To give the shock to any particular place.

Mr. Lane's electrometer to give shocks of the same degree of strength, for medical purposes.

Electric circuit rendered visible.

The electrical fluid takes the shortest way, unless it meets with a better conductor another way.

The electrical fluid the same as lightning, only differing in quantity.

How to preserve buildings, ships, &c.

The electrical pistol.

Electricity useful in curing many diseases.

The Author's name.

LECTURE XI.

GEOGRAPHY.

THAT the earth is a globe, or round ball.

Circles of the sphere, or globe, described, viz.

The equator, meridians, ecliptic, tropics of cancer and capricorn, arctic or northern polar circle, antarctic or southern polar circle.

Latitudes and longitudes of places, what.

Parallels of latitude, difference of latitude and longitude explained.

Of the parallel, right, and oblique spheres, explaining the cause of the different lengths of days and nights in different parts of the world.

Of the torrid, frigid, and temperate zones.

Of

Of climates.

Some problems worked on the terrestrial globe, and on Donn's Panorganon or Ge-organon.

General idea of the construction of maps, as a map of the world, map of a kingdom, &c.

Some problems worked on the celestial globe, and on Donn's improved Analemma.

A general idea of dialling. In an horizontal dial for the latitude of London $51^{\circ}\frac{1}{2}$, the angles which the hour lines make with the meridian, (or 12 o'clock line) are as in the annexed table.

<i>Hours.</i>		<i>Dist. from Merid.</i>	
<i>Morning.</i>	<i>Evening.</i>	<i>d.</i>	<i>m.</i>
XI.	I.	11.	51
X.	II.	24.	19
IX.	III.	38.	3
VIII.	IIII.	53.	36
VII.	V.	71.	6
VI.	VI.	90.	0

Solution of a few paradoxes, if time will permit.

LECTURE XII.

ASTRONOMY.

THE principal phenomena of the Heavens; and amongst these, 1. That the planets Mercury and Venus are sometimes seen to pass before the sun, sometimes to go behind or beyond the sun, making two conjunctions, an inferior and superior.

2. Mercury and Venus are never seen in opposition to the sun, nor indeed very distant from it; Venus in its greatest elongation not exceeding 48 degrees, and Mercury 28; this last is generally so near the sun, as

24 LECTURE XII. continued.

to be seldom seen, being frequently lost in the superior brightness of the sun's rays.

3. That the planets in different parts of their orbits appear of very different magnitudes.

Thus, in particular, Mars sometimes appears as large as Jupiter; at other times so little as not to be distinguished from a fixed star, but by the redness of its aspect.

4. That all the planets appear to move with different degrees of velocity. Sometimes they appear to move in their orbits according to the order of the signs; then to be stationary, then to become direct again, and go on as before.

That system which supposes the earth at rest in the center, and the planets, &c. to revolve round it, is not the true system.

The Copernican or solar system will elegantly solve the phenomena of the sun and planets.

In this system the sun is the central body, about which the earth and the other planets, Mercury, Venus, Mars, Jupiter, and Saturn, and comets, revolve: The moon round the earth; four moons or satellites round Jupiter, and five round Saturn.

The sun is in diameter 895,000 miles, and turns round its axis in 25 days, 15 hours, 16 minutes. Its axis makes an angle with the ecliptic of $82^{\circ} \frac{1}{2}$.

The diameters, periodical revolutions of the planets in their orbits, &c. have been computed to be as contained in the following table.

The T A B L E.

Planets Names	Mercury	Venus	Earth	Mars	Jupiter	Saturn
Characters or Marks	♿	♀	♁	♂	♃	♄
Colours of the Planets	Spark. Red	Vel. White		Fiery Red	Splen. Whi.	Dim Red
Diurnal Motion, or Length of their Days	Unknown	d. b. 24 8*	b. m. s. 23 56 4	b. m. 24 40	b. m. 9 56	Unknown
Periods or Length of their Years.	d. b. m. 87 23 16	d. b. m. 224 16 49	d. b. m. 365 6 9	d. b. m. 686 23 27	d. b. m. 4332 12 20	d. b. m. 10759 6 36
Diameter in Miles	3050	7440	7970	5240	94500	78300
Mean Dist. from the Sun in Miles.	36,841,468.	68,891,486	95,173,000	145,014,148	494,990,976	907,956,130
Pro. of Light & Heat	7	2	1	$\frac{1}{16}$	$\frac{1}{27}$	$\frac{1}{96}$
Inclination of their Orbits to the Eclip.	d. m. s. 6 54 0	d. m. s. 3 20 0	d. m. s. 0 0 0	d. m. s. 1 52 0	d. m. s. 1 20 0	d. m. s. 2 30 0
Places of their	d. m. 14 43 8	d. m. 14 34 11		d. m. 18 9 8	d. m. 8 32 25	d. m. 21 26 25
Node	d. m. 14 43 11	d. m. 14 34 4		d. m. 18 9 11	d. m. 8 32 18	d. m. 21 26 18

☿ These distances of the planets from the Sun, are calculated by supposing the Sun's parallax 8 sec. and a half, agreeably to the observations of the transits of Venus in 1761 and 1769.

The names of the twelve Signs and their Characters are: *Northern*, Aries ♈, Taurus ♉, Gemini ♊, Cancer ♋, Leo ♌, Virgo ♍, Libra ♎, Scorpio ♏, Sagittarius ♐, Capricornus ♑, Aquarius ♒, Pisces ♓.

* By *Bianchini's* observations, but according to others, in 23 b. 20 m.

26 L E C T U R E XII. continued.

Transits of Mercury and * Venus explained.

Venus has phases like our moon.

Annual and diurnal motions of the earth, cause of the seasons explained, &c.

The truth of the solar system, or the annual and diurnal motions of the earth, proved.

L E C T U R E XIII.

ASTRONOMY continued.

THE moon is in diameter about 2175 miles; and is at its mean distance from the earth about $60\frac{2}{3}$ semidiameters of the earth from the earth. Its greatest being $64\frac{2}{3}$, and least $55\frac{1}{3}$.

The moon performs its revolution in its orbit round the earth in 27 d. 7 h. 43 m. called a periodical month: But the time from one inferior conjunction to another inferior conjunction is 29 d. 12 h. 44 m. called the synodical month. The inclination of the moon's orbit to the ecliptic is about $5^{\circ}\frac{1}{4}$.

The moon's node has a retrograde motion, making a revolution in 18 years, 224 days, 5 hours.

The moon always keeps the same face towards the earth.

Her phases explained.

* It is supposed there have been but three transits of Venus observed since the creation of the world. The first was calculated and observed in the year 1639, by Mr. *Jeremiah Horrox*, a young gentleman near Liverpool. The two others I have myself had the pleasure of calculating and observing; one on the 6th of June, 1761, in the morning, at Bideford, in Devonshire; the last on the 3d of June, 1769. This transit begun according to calculation (London time) at the earth's center, at 7 h. 15 m. in the evening, middle 10 h. 25 m. at night, end 1 h. 35 m. the next morning.

An

LECTURE XIII. continued. 27

An eclipse of the moon explained.

That the moon is an opaque body.

That the sun is much greater than the earth.

That the earth is greater than the moon.

That the earth is a globe or round ball, proved.

Eclipses of the sun explained.

Why more eclipses of the moon seen than of the sun.

Always in 18 years, 11 days, 7 hours, 43 minutes, there is a conjunction of the sun and moon with the same node; and therefore, in that time, there is a period or restitution of the same eclipses.

The darkness at the time of our Saviour's crucifixion could not be a natural eclipse of the sun, but supernatural.

The phenomenon of the harvest moon accounted for.

LECTURE XIV.

ASTRONOMY continued.

ECLIPSES of the satellites or moons of Jupiter and Saturn explained.

The satellites appear to move sometimes direct, sometimes to be stationary, and sometimes to move retrograde.

JUPITER'S MOONS.

Satellite	Dist. in Semid. of J	Periodic. Revolution <i>d. h. m.</i>
1	5.667	1 18 27
2	9.017	3 13 13
3	14.384	7 3 42
4	25.299	16 16 32

SATURN'S MOONS.

Satellite	Distan. in Semidiamet. of the Ring.	Periodical Time. <i>d. h. m.</i>
1	2.10	1 21 18
2	2.69	2 17 41
3	3.70	4 12 25
4	8.70	15 22 41
5	25.35	79 7 48

Phænomenon of Saturn's ring explained.

Delineations of the orbits of the planets shewn.

A planet's describing equal areas in equal times explained.

28 LECTURE XIV. continued.

A short account of Sir Isaac Newton's excellent system of gravitation.

That such a power as gravity really exists in the heavens as well as on the earth, and consequently that the Newtonian system is not an hypothesis, but a real matter of fact.

General idea of the tides.

Tides owing to the attraction of the sun and moon, &c.

Of spring and neap tides, &c.

Why clocks are said in the common almanacks to be so much faster or slower than the sun.

Difference between solar and siderial time.

To regulate clocks.

Why the constellations of the stars, called the twelve signs, are delineated about a sign, or 30 degrees, from the places bearing their names.

Phænomena of comets.

The first comet observed with a necessary degree of accuracy was that of 1577, by Tycho Brahe.

Dr. Halley thinks the comet which Apian observed in 1531, is the same which Kepler and Longomontanus more accurately observed in 1682. Hence he ventured to foretell it would return again about the end of the year 1758; and it did return the beginning of the year 1759. Another comet was observed in 1680, and it is supposed will return again in about 575 years, or about the year 2255.

There are but few comets whose periods are as yet known.

The number of comets which have been observed are about 40.

It is computed that the comet of 1680 passed so near the sun, as to be heated 2000 times hotter than red hot iron.

A comet is a dense, durable body, and emits a tail opposite to the sun, which increases as it approaches the sun, &c.

P H I L O S O P H Y

BEING in its present improved state too copious in matter to be comprized in *twelve lectures*, the number which has been usually given for a *guinea*, I have given *fourteen*; notwithstanding which, I find myself obliged to put the two following as *additional lectures*, which may be read when convenient, at *one shilling* and *sixpence* each, to subscribers, if desired by ten or more.

Additional LECTURE on CHEMISTRY,

(As a Supplement to LECTURE I.)

Which may be given after LECTURE VI.

THIS Lecture treats of sundry permanent elastic fluids, by some called Gases, by others Airs.

By the action of certain menstruums, &c. on various bodies, several kinds of these fluids may be produced.

FIXED AIR.

Thus FIXED AIR, or CALCAREOUS GAS, as it is called by different authors, may be produced by putting some chalk in water, and then pouring in some oil of vitriol.

Fixed air is heavier than common air, as $1\frac{7}{10}$ to 1. Fire will not burn, nor life be sustained in it; and therefore this kind of air is by miners called the suffocating or *choak damp*.

Fixed air may be purified by lime, &c.

May be refixed in water.

Is acidulous, changing the tender vegetable blues, as an infusion of violets to a red colour.

DEPHLOGISTICATED AIR.

By dephlogisticated air we mean air deprived of the phlogiston or inflammable principle.

Dephlogisticated air may be produced from red lead and the nitrous acid.

This air is much purer than common air; a candle will burn much more lively and sparkling in it than in common air.

This air is but a little heavier than common air.

Dephlogisticated air decomposes more nitrous air than its own measure of common air, according to its superior goodness,

INFLAMMABLE AIR.

Inflammable air may be produced from iron filings in water, with the vitriolic acid.

One measure of inflammable and two of common air will explode at a candle, &c.

Dephlogisticated air one part and inflammable air two parts will explode at a candle much louder than if common air is used instead of dephlogisticated.

This air is frequently met with in mines, and called the *fire damp*. Also many times found on the surface of water, in pools, &c.

This air is lighter than common air, as $11\frac{1}{4}$ to 1.

NITROUS AIR.

Nitrous air may be produced from iron or copper filings, with two parts of water and one of the nitrous acid.

Nitrous air is the test to examine the purity of common air by: the degree of salubrity of respirable air being always in proportion to the diminution suffered in the sum of the original bulk of the respirable and nitrous air, after they are mixed together.

Nitrous air is a most powerful antiseptic.

Additional LECTURE on OPTICS.

THE Newtonian doctrine of light and colours explained. Notwithstanding the uniform appearance of light, the rays whereof it is composed are of different colours, as may be shewn by the coloured *Spectrum*, as the light of the sun passing through the prism will be differently refracted, and the least refrangible will be *red*, the next *orange*, then *yellow*, *green*, *blue*, *purple*, and the most refrangible *violet*.

These colours are not owing to any thing accidental in refraction through the prism, but are absolutely in the solar rays.

Bodies appear of different colours from their aptness to reflect some sort of rays more copiously than the rest.

Whiteness is a mixture of all colours in due proportion.

Blackness denotes a relative absence of all sorts of rays.

If a change be made in the size or density, &c. of the component parts whereof a body is composed, by their action on each other, the colour of the body becomes changed. Hence colours

colours may be produced, destroyed, or restored; of which CHEMISTRY furnishes many instances.

The rainbow accounted for, and explained.

It is always opposite to the sun.

Sir Isaac Newton was the first who gave a compleat solution thereof.

There are generally two rainbows, one over the other; the lowest or interior is called the primary; in it the colours from the inside to the outside of the bow are in this order: violet, indigo, blue, green, yellow, orange, red.

In the secondary bow, the order is reversed.

Why the primary bow is brighter than the secondary, &c.

Why they appear parts of circles.

General construction of microscopes and telescopes, &c.

And if the sun shines clear, and the room is convenient, an exhibition of some objects by the solar microscope, or megalascope, may be given.

A LECTURE on GEOMETRY.

THE design of this lecture is to prove the principal propositions mechanically, and apply them to measuring heights of objects; and the rationale of measuring land, timber, &c.

The necessary definitions explained, viz. 1. a point, mathematical and physical; 2. a right line; 3. a curve line; 4. a plane surface; 5. a solid; 6. an angle; 7. a circle, degrees, minutes, &c. 8. a triangle; 9. parallel lines; 10. an oblong, or right angled parallelogram.

THEOREMS.

1. A line standing on another making angles with it, the sum of these angles is equal to 180 degrees, or two right angles.

2. If several lines stand on the same line at the same point, the sum of all the angles which they make are together equal to two right angles, or 180 degrees.

3. All the angles made about a point are together equal to four right angles, or 360 degrees.

4. If two lines intersect each other, the opposite angles are equal.

5. If a right line crosses two parallel lines, the adjacent angles, that is, those on the same side, are equal to each other.

6. If

6. If a right line crosses two parallel lines, the alternate angles are equal.

7. The angles at the base of an isosceles triangle (that is, one having two equal sides) are equal. This is frequently called the asses bridge.

8. Equiangular triangles are equilateral.

9. Any two sides of a triangle are greater than the third.

10. The external angle of a triangle is equal to the two internal opposite angles.

11. The three angles of a triangle taken together are equal to two right angles, or 180 degrees.

12. The greater side of a triangle is opposite to the greater angle; *et contra*.

13. The angle at the center of a circle is double of the angle at the circumference standing on the same arc.

14. The opposite angles of a four sided figure inscribed in a circle are together equal to two right angles, or 180 degrees.

15. The angles in the same segment of a circle are equal to each other.

16. The angle in a semi-circle is a right angle.

17. Equiangular or similar triangles have their like sides proportional; that is, as any side in one triangle is to the like side in the other, so is any other side in the first triangle to the like side in the other.

18. The last theorem applied to finding the heights of objects when the sun shines.

19. To find the height when the sun does not shine.

20. Another method when the sun does not shine.

21. The Pythagorean theorem. That the squares on the two shorter sides of a right angled triangle taken together, are equal to the square on the longest side.

22. The Pythagorean theorem applied to architecture.

23. Applied to navigation.

GEOMETRY applied to MENSURATION of LANDS,
TIMBER, &c.

24. To measure a rectangle.

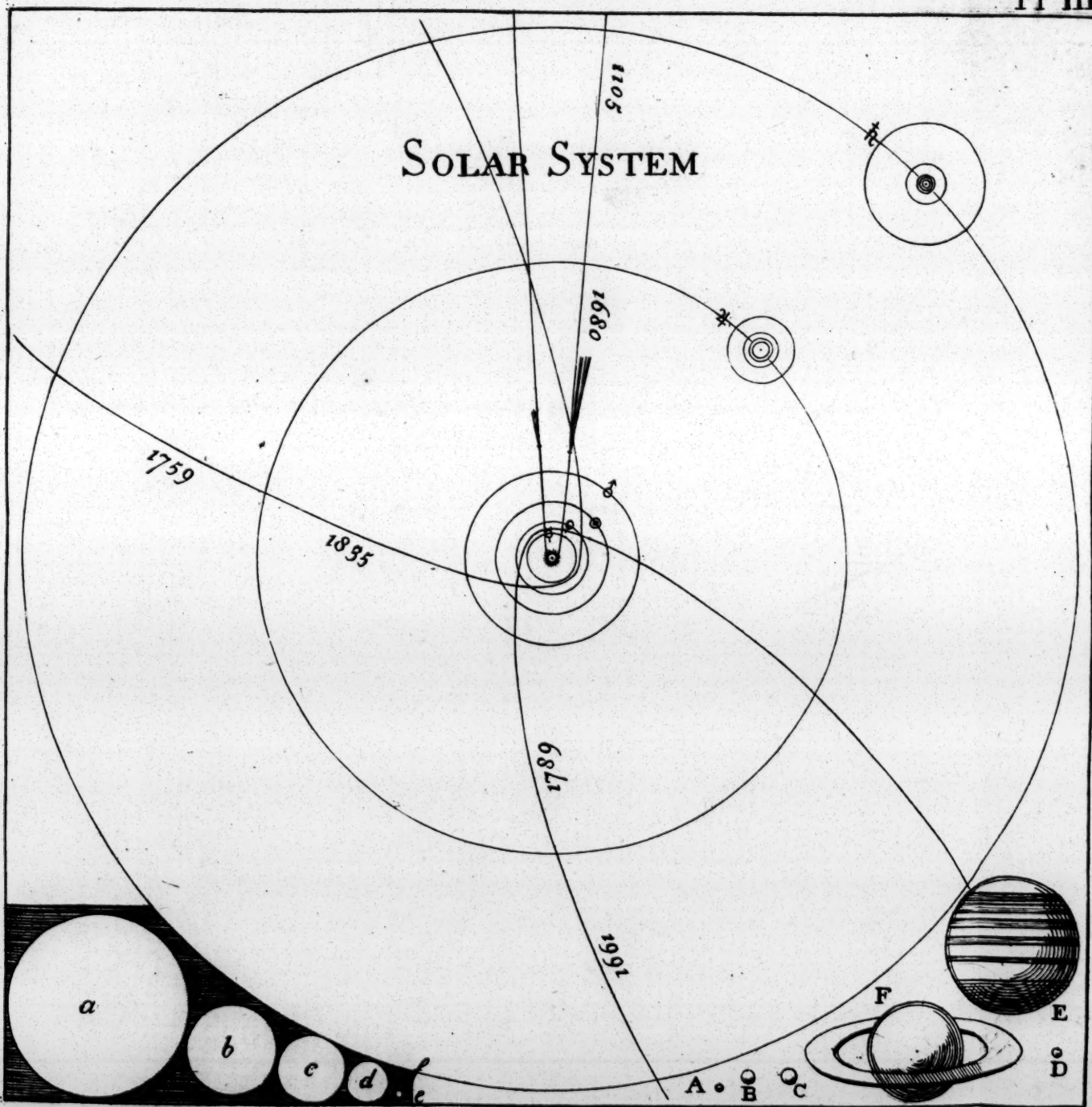
25. To measure a triangle.

26. To measure a field of several sides.

27. To measure a regular polygon.

28. To measure a circle.

29. Pro-





29. Proportion of similar surfaces are as the squares of their like sides.

SOLID GEOMETRY.

30. To measure a parallelopipedon.

31. To measure a prism.

32. To measure a cylinder.

33. A pyramid is a third of its circumscribing prism. Hence to measure it.

34. A cone is a third of its circumscribing cylinder. Hence to measure it.

35. A sphere or globe is two thirds of its circumscribing cylinder. Hence to measure it.

36. Similar solids are in proportion to each other as the squares of their like sides.

37. Application of solid geometry to gauging.

38. To measure very irregular solids.

39. Study of geometry in the method of the ancients recommended.

A LECTURE on NAVIGATION.

THE design is to convey general ideas to ladies and gentlemen how it is possible to conduct ships from one country to another.

Action of wind on * sails.

To turn a ship to the right hand or left.

Starboard and larboard explained.

To find lee way.

To wear and tack a ship.

How the course steered and distance sailed is estimated.

To find the course and distance from one place to another by Mercator's chart, and its construction.

By the course and distance sailed to find the latitude and longitude in.

To find the latitude by observation of the sun.

Longitude in may be found by eclipses, &c.

To find the variation of the compass, &c.

* The best position of rudders and sails may be seen in my Essay of the 6th of June, 1751, published in *Miscellanea Curiosa Mathematica*.

T H E
EXISTENCE, WISDOM, and POWER
O F
T H E D E I T Y,

MANIFEST FROM A

Summary View of the preceding LECTURES.

Published at the Request of several SUBSCRIBERS.

WE have now taken a survey of some of the laws by which the material world is governed ; and with a little attention the hand of wisdom, power, and goodness may be seen through the whole.

To give a few instances, being the hasty thoughts of less than an hour.

First, As nothing can act where it is not, was it not for the surprising *divisibility of light*, &c. how could we feel the effects of the vivifying power of the sun, so necessary to the growth of animals, vegetables, &c. that without the influence of his benign rays, that admirable organ the eye would be rendered useless ; and even life itself could not be sustained. Does not this mark the hand of wisdom, goodness, and power ?

2d, *The attraction of cohesion*, without which there would not be any such thing as firm, compact, or solid bodies ; all would be a kind of sand or powder. Without this also the sap would not rise in the capillary tubes of vegetables ; without which there could not be any increase of their bulk ; and consequently no such thing as plants, trees, &c. and therefore no corn or fruits of the earth for the nourishment of man.

3d, If

3d, If it was not for the *gravity or weight of bodies*, by which every particle of matter of which the earth is composed tends towards the center ; by the earth's revolving so swiftly round its axis every day, all bodies would be thrown off in the same manner as water from a grinding-stone, and from the same cause, and so the earth itself be entirely dissipated, should this attraction cease.

4th, The *magnetical attraction* ; how admirable is it adapted for the purposes of navigation ? for the conducting of ships through the trackless paths of the sea, though the land which sinks below the horizon affords no direction ! Without which we should lose the numerous productions of foreign countries, so necessary to the conveniencies and elegancies of life.

5th, As *solidity* of bodies is necessary for building places of habitation, and numberless other instances, so is also *fluidity*, without which we could not have any water or other liquid. Were it not for the *pressure of fluids*, as has been shewn in our lectures, ships could not swim on the sea, vapours, &c. could not rise from the earth, and form an atmosphere of air, clouds, &c. Without air and its springiness, the lungs of animals could not expand ; men and other animals could not exist ; without a motion in the air, called wind, it would become stagnant and corrupted ; pestilential diseases instantly occur, and death ensue.

Without clouds, no rain or snow, and consequently no vegetation or life ; the earth would soon become a dreary desert, affording not even barely sufficient for life. Also without clouds there would be no electrical explosion, and consequently no thunder and lightening ; which, though by some looked on as an evil, is yet productive of great good, cleansing and purifying the air, a quality absolutely necessary to prevent the most fatal diseases.

The hand of wisdom, goodness, and power also evidently appears in proportioning the quantity of rain to the growth of vegetables and other purposes, so as not by too great a quantity deluging the earth, or by a defect in quantity making it become a desert.

6th, By the *universal law of gravitation*, the tides of the ocean ebb and flow for bringing in and carrying out our ships. By this means also the water continues pure, which otherwise would soon become putrid, and produce such nauseous effluvia as would be dangerous, yea more, would certainly corrupt the air to such a degree, as to destroy all animals.

Another instance of wisdom, power, &c. is the exact limits to which the sea is confined, never exceeding its established bounds, though ever so much disturbed by the stormy wind!

7th, By this *law and centrifugal force* are the planets so exactly kept in their orbits. Does it not require infinite wisdom to adjust these powers so exactly to each other, that the heavenly bodies have so regularly kept their motions for so many ages?—If with their present velocities or centrifugal forces, the law of gravity was either more or less than in the exact proportion of the inverse ratio of the squares of the distances from the sun, the system would be immediately destroyed. If the law was as the simple power of the distance, or in any other power less than the square, all the planets would fly off in endless space, by the excess of centrifugal force, and never return. If on the contrary the law was as the cubes of their distances, by the excess of centripetal force they would all fall into the sun.

Now even from this cursory and hasty view of the principal laws by which the material world is governed, does it not evidently appear, that it is in the greatest degree ridiculous to suppose chance, or a fortuitous concourse of atoms, could be the cause of so much order and regularity; even so great, that nothing less than infinite goodness, wisdom, and power, seems capable of willing, contriving, and executing!

Hence Sir *Isaac Newton*, at the end of his *Principia*, might well observe, that, “to discourse of GOD, from the appearances of things, does certainly belong to natural philosophy.” I shall therefore beg leave to follow so great an example, and observe, that this most beautiful system could only proceed from the counsel and dominion of an intelligent, powerful, wise, and good Being, whom we call GOD.

GOD

GOD must have existed from all eternity ; for if there ever was a time in which nothing existed, it would be impossible that any being should now exist ; for mere nothing cannot produce any thing.

This self-existent eternal *Being*, being the origin and cause of all the power and wisdom of all other beings, must himself be all-powerful and all-wise.

We have ideas of the attributes of GOD ; we know that he is the Lord of all things, the Creator of the universe, a Being in the greatest degree perfect, whose wisdom, power, justice, truth, and goodness are infinite. A Being, of whose substance we have no idea.

Let us stretch our faculties to the utmost, to form to our minds the most perfect being we possibly can ; and even then we must acknowledge him to be infinitely more perfect. Such an infinitely powerful and good Being is the self-existent GOD, that we can only know him by his most excellent contrivances and dispensations of all things ; we admire him for his perfections, and we worship him on account of his dominion over us.

Sir Isaac Newton accurately observes, that “ GOD governs
“ all things, not as the soul of the world, but as Lord over
“ all. He is eternal and infinite, omnipotent and omniscient ;
“ that is, his duration reaches from eternity to eternity, his
“ presence from infinity to infinity ; he governs all things,
“ and knows all things, that are or can be done. He is not
“ eternity or infinity, but eternal and infinite. He is not
“ duration or space, but endures and is present.—GOD is
“ always and every where, not virtually only, but also sub-
“ stantially ; for virtue cannot subsist without substance.

“ It is allowed by all, that the supreme GOD exists necessarily, and by the same necessity he exists always and
“ every where.”

GOD's being present in or to the world, does not make him to be the soul of the world ; a soul is a part of a compound, whereof body is the other part, and they mutually affect each other, as parts of the same whole. But GOD is present to the world, not as a part, but as a governor, acting

ing upon all things, is himself acted upon by nothing. He is not far from every one of us, for in him we and all things live and move, and have our being.

Though I have been already longer than I intended, yet the following lines of the pious Bishop Beveridge are so beautiful, that I know not how to omit them.

He observes, that "when GOD speaks of himself, and his own eternal essence, he saith, *I am that I am*; so when he speaks of himself with reference to his creatures, and especially to his people, he saith, *I am*. He doth not say, I am their light, their life, their guide, their strength, or tower; but only I am. He sets, as it were, his hand to a blank, that his people may write under it what they please, that is good for them. As if he should say, are they weak? I am strength. Are they poor? I am rich. Are they in trouble? I am comfort. Are they sick? I am health. Are they dying? I am life. Have they nothing? I am all things. I am wisdom and power; I am justice and mercy; I am grace and goodness; I am glory, beauty, holiness, eminency, supereminency, perfection, all-sufficiency, eternity, Jehovah. I am whatsoever is suitable to their nature; or convenient for them in their several stations, that I am. Whatsoever is amiable or desirable in itself, that I am. Whatsoever is pure and holy; whatsoever is great or pleasant; whatsoever is good or needful to make men happy, that I am. So that in short, GOD here represents himself unto us, as an universal good, and leaves us to make application of it to ourselves, according to our several wants, capacities, and desires, by saying only in general, I am."



E R R A T U M.

Page 8, line last, for *iron* 153, read *tin* 153.

*Having an Inclination to publish, and add to this Syllabus,
a Plate of the SOLAR SYSTEM, Price Three-Pence,
we shall here annex an Explanation.*

THE Orbits of the respective Planets are distinguished by their Characters. The Orbits of three Comets are also delineated, with the Years of their Appearances. In the right Corner are given the proportional Magnitudes of the Planets, the Sun being supposed equal to the Orb of Saturn, or about 6 Inches Diameter.—A, is Mercury; B, Venus; C, the Earth; D, Mars; E, Jupiter, with his Belts; F, Saturn, with his Ring.

In the left Corner are given the proportional apparent Diameters of the Sun, as seen from the several Planets. Thus, supposing at Mercury the Sun appears as big as Fig. *a*; in Venus it would appear no bigger than *b*; at the Earth than *c*; at Mars *d*; at Jupiter *e*; and at Saturn *f*.

*The following BOOKS and INSTRUMENTS, &c. are
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BRISTOL, June 1, 1780.

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☞ See Back of the Title Page.

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By BENJAMIN DONN and ASSISTANTS.
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